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Original Research Article

A Prospective Observational Study to Evaluate the Role of Levobupivacaine with Dexmedetomidine in Supraclavicular Brachial Plexus Block in Patients Undergoing Upper Limb Orthopaedic Surgeries

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ABSTRACT

Background: Supraclavicular brachial plexus block provides effective, low cost and very safe anaesthesia with good postoperative analgesia. This study was conducted to evaluate the postoperative analgesic efficacy and safety of dexmedetomidine for brachial plexus blockade along with levobupivacaine.

Methods: This prospective observational study was conducted on 50 ASAI/II patients of age 18 to 60 years posted for various upper limb surgeries. The patients in this study received 1.5% xylocaine with adrenaline (20 millilitre) and 0.5% levobupivacaine (16 millilitre) plus dexmedetomidine 50 µg (1 mililitre) making a total volume of 37 ml via supraclavicular route. Assessment of motor and sensory blockade, pulse, systolic blood pressure, diastolic blood pressure and mean arterial pressure, SPO2 and side effects were noted every 5 minutes for first 30 minute and every 15 minute till end of surgery. Duration of analgesia and incidence of various complications following the procedure were observed.

Results: Post-hoc bonferroni test is used for the inter-group comparison of mean HR, SBP, DBP and MAP between different time intervals. A significant difference was observed among all variables. The mean onset of sensory block was 342.50±89.56, mean duration of sensory block was 959.25±186.61, mean onset of motor block was 239.05±62.21, mean duration of motor block was 1059.35±252.35 and mean duration of analgesia was 1254.96±243.62.

Conclusion: Dexmedetomidine with levobupivacaine in supraclavicular block provides better hemodynamic stability and greater postoperative analgesia.

Keywords: Levobupivacaine, Dexmedetomidine, Brachial Plexus Block.

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INTRODUCTION

Modern world may be called as the world of regional anaesthesia.[1] In upper limb orthopedics surgeries, regional anaesthesia is a better option for elective as well as emergency procedures on the hand, forearm and elbow. Regional nerve block is a deliberate interruption of signals which travels along a nerve so that pain can be relieved. Regional anaesthesia has become very popular for orthopaedics upper limb surgeries as it gives many benefits over GA.[2,3] Brachial plexus blockade is very popular regional technique for arm and forearm surgeries because the unexpected effects of GA/instrumentation of upper airway are avoided. For an anaesthetist, the most important benefits of regional anaesthesia are respiratory and cardiovascular stability, preservation of protective airway reflexes and rapid postoperative recovery.[4] This is more important in chronically ill patients or in those with serious systemic diseases such as diabetes, hypertension, cardiovascular, respiratory or renal diseases.

Various techniques have been explained for brachial plexus block, but supraclavicular approach demands less expertise and is the most consistently used approach for anaesthesia and analgesia for surgeries below the shoulder joint.[5] This approach is attractive because it is very effective in terms of performance, margin of safety along with better postoperative analgesia. All portion of upper extremity are effectively blocked by this technique and is executed at the level of trunks of brachial plexus. The plexus is blocked where it is most compact i.e. at the middle of brachial plexus, producing a cognate disperse of drug throughout entire plexus with a rapid and total blockade.[6] To extend the duration of analgesia, various adjuvants can be used with varying degrees of

success. Tramadol, clonidine, sodium bicarbonate, fentanyl, epinephrine, buprenorphine, dexamethasone, parecoxib and magnesium are used to provide a longer efficacy in reduced anaesthetic doses to avoid toxicity, to decrease the time to start the operation and to provide better quality of analgesia and anaesthesia.[7] An ideal adjuvant for peripheral nerve block has always been in a search which can increase the duration of analgesia with minimum side effects.[8]

Levobupivacaine is a new and safer agent which is now used into clinical practice and has significantly less CNS and cardiac adverse effect than racemic bupivacaine.[9] Levobupivacaine is the S-enantiomer of bupivacaine which has been proved to be safe and effective drug for brachial plexus as well as central neuroaxial block. It seems promising when there is less systemic toxicity and reduced the need of large amount of drug in peripheral nerve blocks by the use of levobupivacaine.

Dexmedetomidine is highly selective alpha – 2 adrenergic agonist which was approved by the FDA in 1999 for human use. It belongs to imidazole subclass of α2 agonists.[10] It is eight times more potent than clonidine. Low plasma concentrations result in analgesia, sympatholysis and mild sedation without any respiratory depression. Also, perineural Dexmedetomidine causes augmentation of local anesthetic effect without causing nerve damage.

Based on the above promising effects of levobupivacaine (0.5%) and significant analgesic and sedative effects of selective α2 adrenergic agonist we choose dexmedetomidine together with levobupivacaine in brachial plexus block via supraclavicular technique for below shoulder surgeries.

MATERIALS AND METHODS

This study was conducted in Department of Anaesthesiology, Teerthankar Mahaveer Medical College Moradabad during period 2015-2016.

Selection of Patients

After taking permission from the Ethical Committee, the study was conducted on 50 patients in Teerthankar Mahaveer Medical College & Research Centre after taking due written informed consent. Patients of either sex, ASA grade I/II, 18 - 60 years aged undergoing hand, forearm and arm surgeries were taken for the study.

Exclusion Criteria

- Patient not willing for surgery,
- Weight> 90 kg,
- Inadequate/patchy block,
- Bleeding disorders,
- Patients on anticoagulants drugs,
- With severe respiratory depression/disease,
- With neurological deficit which includes brachial plexus,
- Infected injection site,
- Allergic to LA agents and pregnant women.

In this study, all patients received 1.5% xylocaine with adrenaline (20 ml) and 0.5% levobupivacaine (16 milliltre) plus dexmedetomidine 50 µg (1 millilitre) making a total volume of 37 millilitre.

After ensuring proper pre-operative fasting, premedication with intravenous Inj. Ondansetron in the dose of 4 mg was given to all patients. Continuous monitoring of Systolic blood pressure, diastolic blood pressure, mean arterial blood pressure, pulse rate, respiratory rate, oxygen saturation, and Electrocardiogram (ECG) was done.

Before undertaking the procedure, an intravenous drip was started which was continued till the end of surgery. Vitals of all patients were observed during the procedure and oxygenation was done @ 5litre/min through Hudson mask.

After taking all aseptic precautions, Brachial plexus block via supraclavicular technique was performed in the lying down position. Patients were asked to turn the head to different side with his arms pulled towards the knee. Identification of the EJV, midclavicular point, and subclavian artery pulsation was done. A 22 G, 1.5 inch needle have to be introduced approx 2 cm above the midclavicular point and just lateral to subclavian artery pulsation and directed caudad and medially until patient encountered the paraesthesia. 37 milliliters of LA with dexmedetomidine was injected in the perineural area. Intravenous inj of midazolam 1-1.5 mg was given to all the patients for sedation. Routine monitoring was done and any unexpected effects were also being noted.

After recording the demographic data, non-invasive blood pressure, heart rate and oxygen saturation (SpO_2) of the patient was recorded at the beginning of the surgery then at every 5 till 30 minutes of block administration and then in every 15 minutes till the completion of surgery.

We elicited the time of onset of sensory block. It is the time between perineural inj. and onset of analgesia in every major distributions of peripheral nerves i.e “radial, ulnar, medial and musculocutaneous nerve”. By using the blunt end of needle of size 27G, sensory block was assessed by pinprick at 0min, 2min, 5min, 10min, 15min, 20min and 30 min. Surgery was started after performing brachial plexus block and confirming the onset of analgesia. Time of injection of LA/ onset of analgesia was noted. In post-operative unit, duration of analgesia was measured. When patients complain of pain, rescue analgesia was given. The onset/ duration of analgesia, age of patients were noted.

Time between perineural injection and inability to move fingers/ hand is the Motor block. It was noted at 0min, 10min, 20min, and 30min by assessing the following motor functions: “flexion at the elbow, extension of the elbow and the wrist, opposition of the thumb and index finger, and opposition of the thumb and small finger”. Postoperatively, the duration of motor block was measured every one hourly by seeing the patients whether they are able to move their hand/fingers or not. This time was considered as cessation of motor block effect and recorded accordingly.

During the procedure, without any sedation if the patient was not complaining of discomfort/ pain, anaesthesia was considered satisfactory. In postoperative unit, follow-up of the patients was done. At every ½ an hour for first 10 hours, duration of analgesia was noted according to visual linear analogue score (0-10) for pain and then hourly till 24 hours. Inj. Diclofenac sodium was given at a dose of 1-1.5mg/kg when the patients started to have the maximum pain i.e. visual linear analogue scale is between 8 and 10.

To determine the analgesia in post-operative unit, the interpretation of the VAS scoring was explained 1 day prior to the surgery to the patients taken for the study .This was carried out with a 10 cm line. The mark ‘0’ means ‘no pain’ and mark ‘10’ means ‘severe pain’. The severity of the pain was marked by the patients.

In case of inadequate/patchy action of the block/weaning of block due to undue prolongation of surgery the block was supplemented with general anaesthesia and the patient was not be considered for our study. Possible side effects like nausea, vomiting, allergy to LA, pruritis , Horner's syndrome were looked for, noted and to be managed accordingly.

Statistical Analysis

All statistical analyses were done by Excel 2007 TM (Microsoft, Redmond, WA). Patient demographic characteristics were analyzed by doing 't-test' for independent groups. The results were presented in number, percentage, mean and standard deviation as appropriate. Hemodynamic parameters (PR, SBP, DBP and MAP) by using ANOVA –SINGLE FACTOR and Unpaired T –Test. Block characteristics were analyzed by one way ANOVA – single factor 'A p-value of <0.05 (2-tailed) was taken statistically significant'.

Table 1: Mean Heart Rate

	HR	Mean	Std. Deviation	F-value	p-value[a]	Post-hoc comparisons[b]
1.	Pre-operatively	77.97	13.08	2,227.350		
2.	0 minute	82.75	13.67			
3.	5 minutes	86.51	13.85			
4.	10 minutes	88.94	14.10			
5.	15 minutes	93.47	14.89			
6.	20 minutes	88.24	14.02			
7.	25 minutes	78.15	12.72		< 0.001*	5 > 4, 6 > 2, 3 >
8.	30 minutes	75.19	11.94			1, 7 > 8, 9, 10,
9.	45 minutes	73.34	11.63			11, 12, 13 > 14
10.	60 minutes	72.04	11.34			
11.	75 minutes	72.43	11.42			
12.	90 minutes	70.26	10.87			
13.	105 minutes	68.79	10.60			
14.	120 minutes	67.71	10.42			

[a] Repeated measures ANOVA test

[b] Post-hoc bonferroni test

* Significant difference

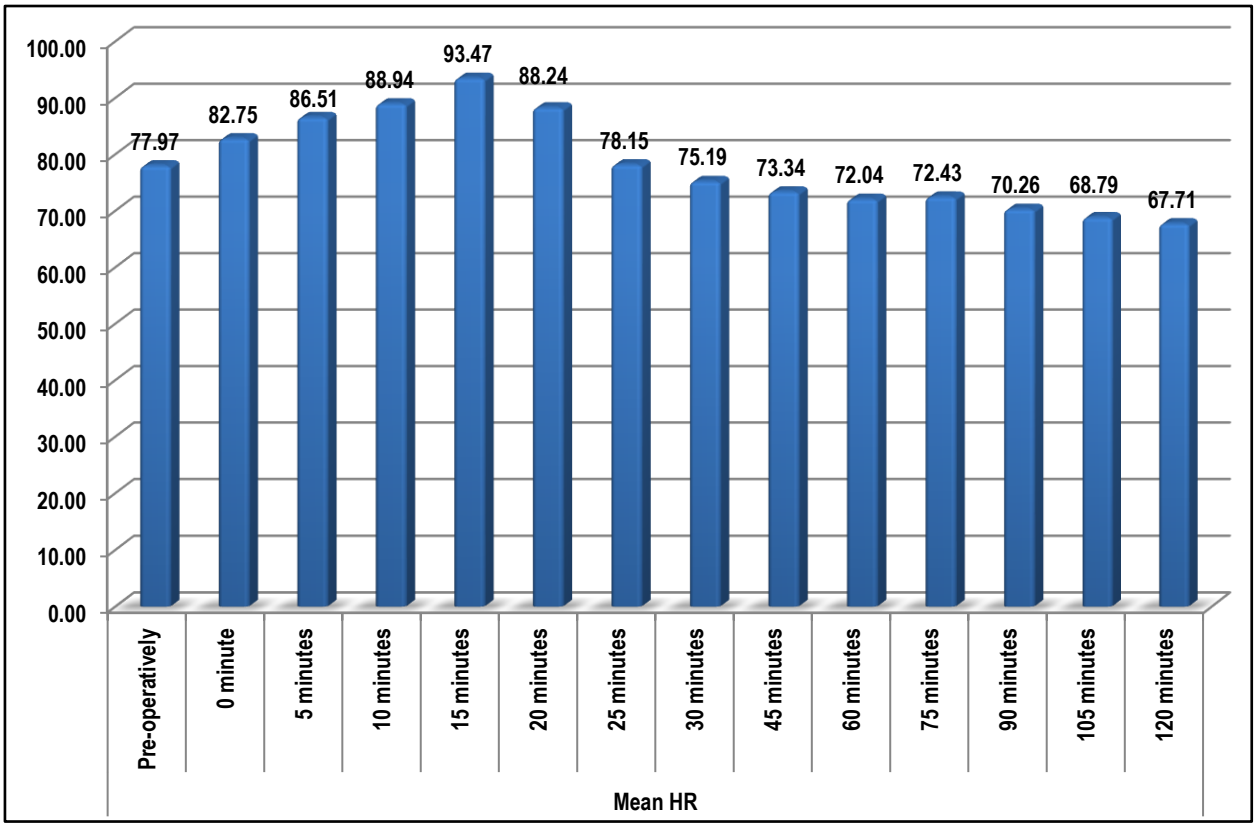

Figure 1: Mean Heart Rate

RESULTS

This study was conducted in Department of Anaesthesiology, Teerthankar Mahaveer Medical College Moradabad during period 2015-2016. After written informed consent, 50 ASAI/II patients undergoing forearm, arm and hand surgery were taken in the study.

Repeated measures ANOVA test is used for comparison of mean HR between different time intervals. There was a significant difference in mean HR between different time intervals. Post-hoc bonferroni test is used for the inter-group comparison of mean HR between different time intervals. The mean HR was significantly more at 15 minutes in comparison to 10 and 20 minutes which was significantly more than 0 minute and 5 minutes which was significantly more than Pre-operatively and 25 minutes which was significantly more than 30, 45, 60, 75, 90 and 105 minutes which was significantly more than 120 minutes.

Between different time intervals, the comparison of mean SBP was done using the Repeated measures ANOVA test. There was a significant difference in mean SBP between different time intervals. Post-hoc bonferroni testis used for the inter-group comparison of mean SBP between different time intervals. The mean SBP was significantly more at 20 minutes in comparison to 10, 15 and 25 minutes which was significantly more than 5 minutes which was significantly more than 0 minute which was significantly more than Pre-operatively, 30, 45, 60, 75 and 90 minutes which was significantly more than 105 and 120 minutes.

Table 2: Mean Systolic Blood Pressure

	SBP	Mean	Std. Deviation	F-value	p-value[a]	Post-hoc comparisons[b]
1.	**Pre-operatively**	123.16	18.44	2,606.047		
2.	**0 minute**	129.22	19.52			
3.	**5 minutes**	133.70	20.16			
4.	**10 minutes**	134.68	20.29			
5.	**15 minutes**	135.16	21.44			
6.	**20 minutes**	139.44	20.43			6 > 4, 5, 7 > 3 > 2
7.	**25 minutes**	135.08	19.78		**< 0.001***	> 1, 8, 9, 10, 11,
8.	**30 minutes**	123.16	18.44			12 > 13, 14
9.	**45 minutes**	121.72	18.37			
10.	**60 minutes**	120.44	17.80			
11.	**75 minutes**	120.02	17.86			
12.	**90 minutes**	116.99	17.38			
13.	**105 minutes**	113.95	16.76			
14.	**120 minutes**	112.24	16.18			

[a]Repeated measures ANOVA test; **[b]Post-hoc bonferroni test**; ***Significant difference**

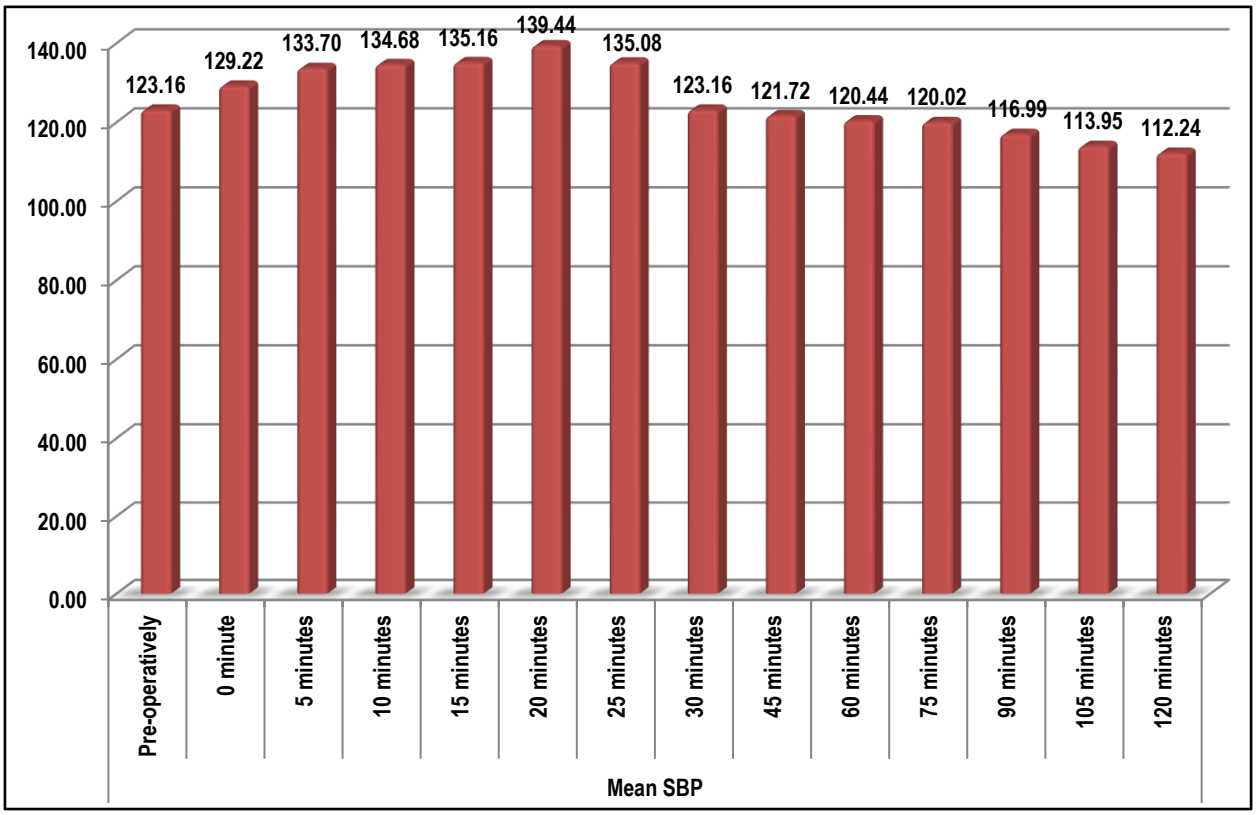

Figure 2: Mean SBP

Table 3: Mean Diastolic Pressure

	DBP	Mean	Std. Deviation	F-value	p-value[a]	Post-hoc comparisons[b]
1.	Pre-operatively	69.71	10.70			
2.	0 minute	73.63	11.05	2,445.977		
3.	5 minutes	77.00	11.46			
4.	10 minutes	78.50	11.82			
5.	15 minutes	82.84	12.15			
6.	20 minutes	79.43	11.76			
7.	25 minutes	82.84	12.15		< 0.001*	5, 7 > 4, 6, 8 > 3, 9 > 2, 10, 11 > 1 > 12 > 13, 14
8.	30 minutes	79.59	11.81			
9.	45 minutes	76.18	11.46			
10.	60 minutes	73.91	11.23			
11.	75 minutes	71.29	11.27			
12.	90 minutes	68.24	10.29			
13.	105 minutes	66.90	9.98			
14.	120 minutes	65.52	9.69			

[a]Repeated measures ANOVA test; [b]Post-hoc bonferroni test; *Significant difference

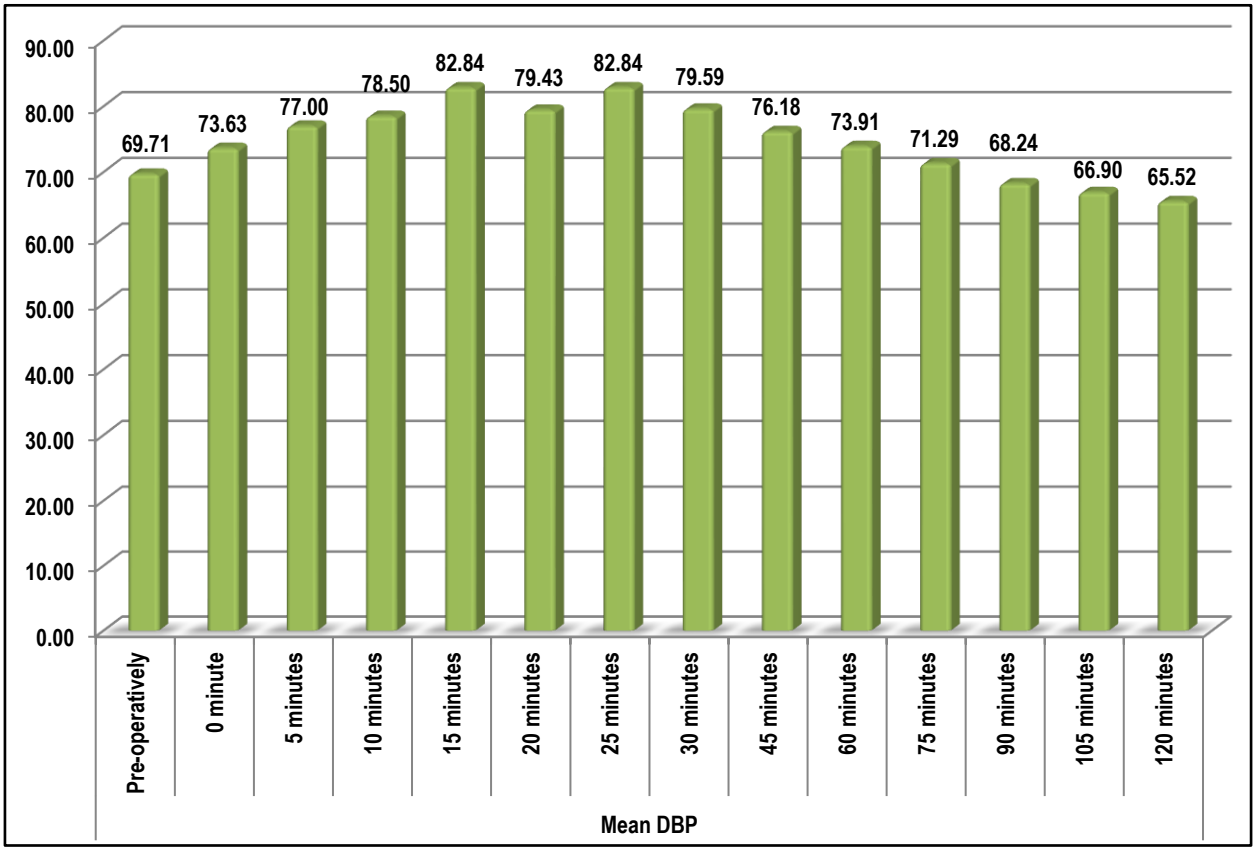

Figure 3: Mean DBP

Repeated measures ANOVA test was used for the comparison of mean DBP between different time intervals. There was a significant difference in mean DBP between different time intervals. "Post-hoc bonferroni test" was used for the inter-group comparison of mean DBP between different time intervals. The mean DBP was significantly more at 15 and 25 minutes in comparison to 10, 20 and 30 minutes which was significantly more than 5 and 45 minutes which was significantly more than 0, 60 and 75 minutes which was significantly more than 90 minutes which was significantly more than 105 and 120 minutes.

Repeated measures ANOVA test was used for the comparison of mean MAP between different time intervals. There was a significant difference in mean MAP between different time intervals. Post-hoc bonferroni test was used for the inter-group comparison of mean MAP between different time intervals. The mean MAP was significantly more at 15, 20 and 25 minutes in comparison to 5 and 10 minutes which was significantly more than at 30 and 45 minutes which was significantly more than at Pre-operatively, 60 and 75 minutes which was significantly more than at 90 minutes which was significantly more than at to 105 and 120 minutes.

The mean onset of sensory block was 342.50±89.56, mean duration of sensory block was 959.25±186.61, mean onset of motor block was 239.05±62.21, mean duration of motor block was 1059.35±252.35 and mean duration of analgesia was 1254.96±243.62.

Table 4: Mean Arterial Pressure

	MAP	Mean	Std. Deviation	F-value	p-value[a]	Post-hoc comparisons[b]
1.	Pre-operatively	87.47	12.71			
2.	0 minute	92.05	13.26	2,565.731		
3.	5 minutes	95.86	13.81			
4.	10 minutes	97.19	14.07			
5.	15 minutes	100.30	14.62			
6.	20 minutes	99.37	14.29			
7.	25 minutes	100.06	14.37		< 0.001*	5,6,7 > 3,4 > 2,8,9 >
8.	30 minutes	93.82	13.44			1,10,11 > 12 > 13,14
9.	45 minutes	91.22	13.38			
10.	60 minutes	89.21	13.04			
11.	75 minutes	87.29	12.67			
12.	90 minutes	84.58	12.24			
13.	105 minutes	82.51	11.85			
14.	120 minutes	81.01	11.57			

[a]Repeated measures ANOVA test; [b]Post-hoc bonferroni test; *Significant difference

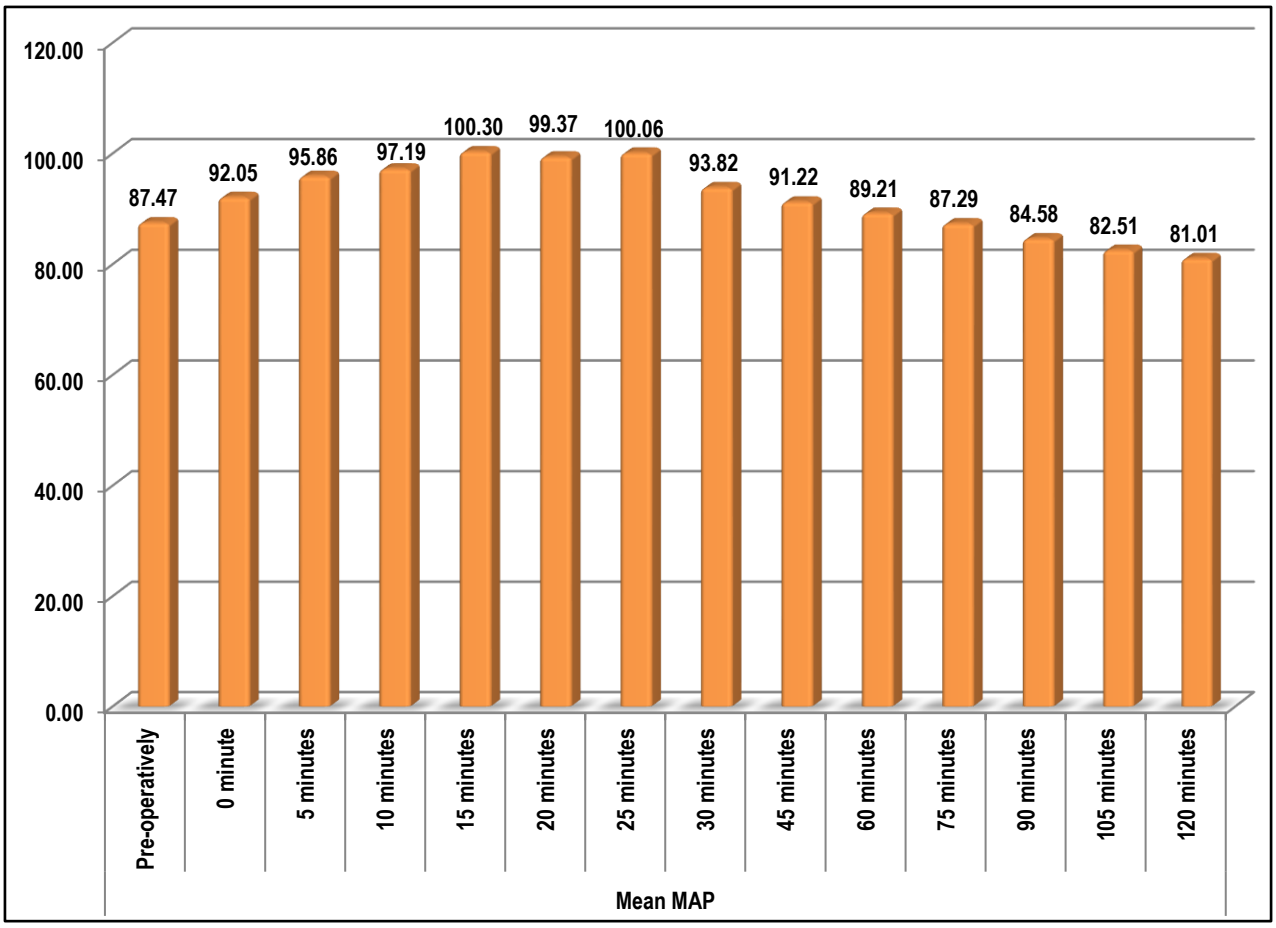

Figure 4: Mean MAP

Table 5: Mean Onset of Sensory/Motor Block.

	Minimum	Maximum	Median	Mean	Standard deviation (n)	Standard error of the mean	Coefficient of Variation
Onset of sensory block	74.30	540.00	330.00	342.50	89.56	12.42	0.26
Duration of sensory block	52.43	1080.00	990.00	959.25	186.61	25.88	0.19
Onset of motor block	51.41	360.00	240.00	239.05	62.21	8.63	0.26
Duration of motor block	190.17	2000.00	1070.00	1059.35	252.35	34.99	0.24
Duration of analgesia	59.13	1460.00	1280.00	1254.96	243.62	33.78	0.19

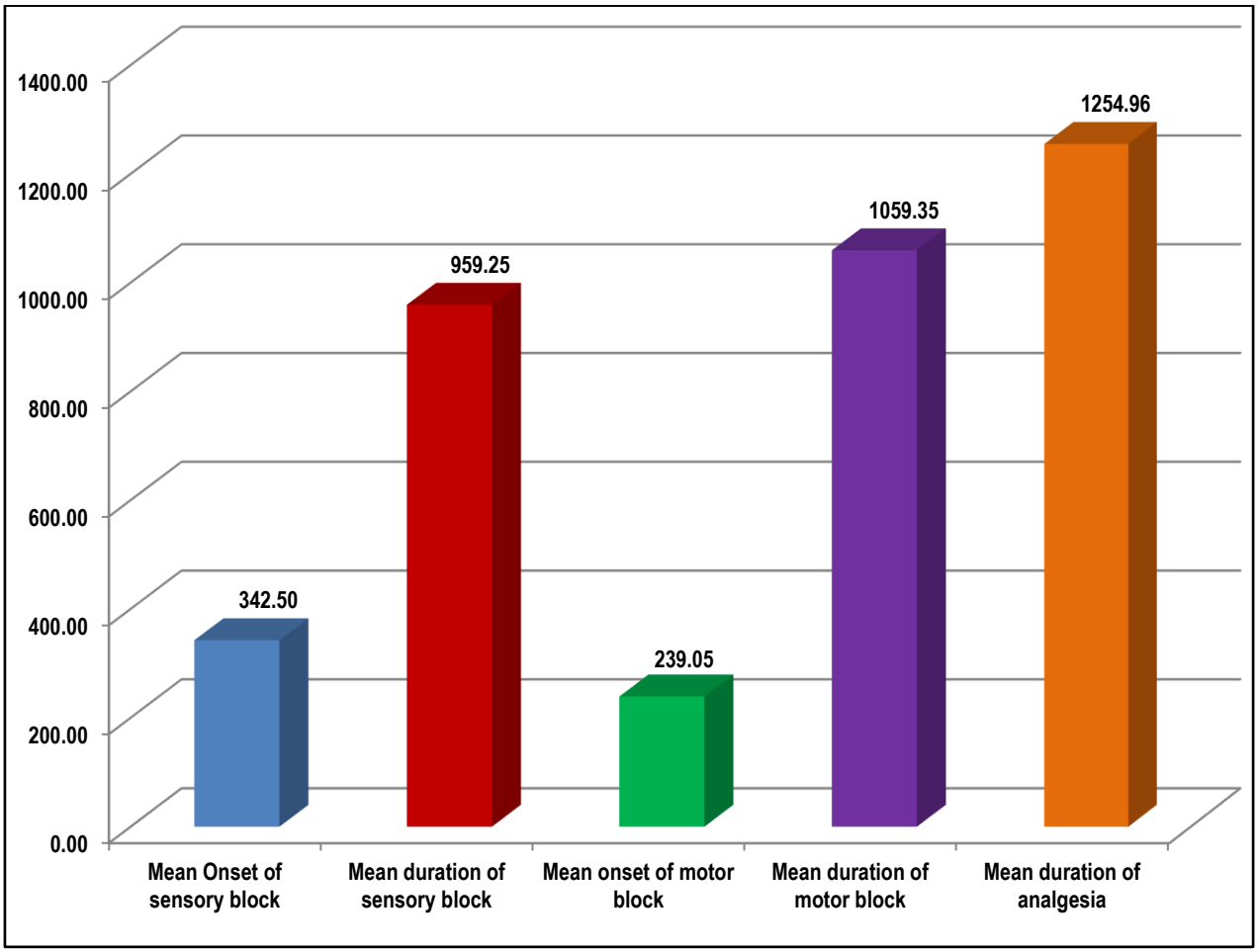

Figure 5: Block Characteristics

DISCUSSION

Brachial plexus block is commonly used as a single anaesthetic technique for upper limb surgeries or may be supplemented with GA. Dexmedetomidine, is a pharmacologically active d-isomer of medetomidine being highly specific and selective α2 adrenoceptor agonist having a α2:α1 binding selectivity ratio of 1620:1 whereas for clonidine (it is 220:1), thus decreasing the unwanted side effects of α1 receptors.[11,12]

Brumett et al. reported that dexmedetomidine has been found to increase the duration of action of bupivacaine in sciatic nerve block without any damage to the nerve in rats. The nerve axons and myelin were found to normal during histopathological examination in both control and dexmedetomidine + bupivacaine groups.[13]

In an another study, when perineural dexmedetomidine in combination with ropivacaine was used for sciatic nerve block in rats, there was a prolongation of the duration of analgesia due to the blockage of the hyperpolarisation-activated cations. This effect was reversed by a hyperpolarisation-activated cation channel enhancer which could not be due to a α_2 adrenoreceptor antagonist. This shows that the analgesic effect of peripheral perineural dexmedetomidine was caused by enhancement of the hyperpolarisation-activated cation current that prevents the nerve from returning from a hyperpolarized state to resting membrane potential for subsequent firing.[14]

The mean sensory block onset time was 342.50±89.56 seconds which was in accordnace with the study by Dixit et al,[15] the mean duration for sensory block onset was 6.85±0.745 minutes and Singh et al.[16] (the mean onset time was 3.24±0.95 minutes), Hosalli et al.[17] reported a mean time for sensory onset to be 8.14±1.08 minutes. However, this was more than the study by Swami et al,[18] in which, the mean time required for onset of sensory block was found to be 1.70±1.28 minutes and Munshi et al.[19] the mean time for onset of the sensory block was 1.93±0.44 minutes. While the mean onset time for sensory block in the study by Agarwal et al.[20] was 16.2±1.8 minutes.

The mean duration of sensory block was 959.25±186.61 seconds which was quite similar to the results reported by Singh et al,[16] (the mean duration for sensory block was 16.31±2.606 minutes). While, this was lesser than the study by Al-Mustafa MM et al,[21] the mean duration for sensory block was 261.5±34.8 minutes, Swami et al.[18] in which, the mean duration for sensory block was 413.97±87.31 minutes, Hosalli et al.[17] (the mean sensory block time was 423.17±80.01 minutes), Biswas et al.[22] the mean duration of sensory block was 898±32.33 minutes, Ghali et al.[23] (sensory block duration was reported to be 499.10±51.76 minutes for the patients undergoing Vitreoretinal Surgery with Sub-Tenon's block anesthesia).

Bajwa et al.[24] did comparison of clonidine and dexmedetomidine for the epidural anesthesia and found on the basis of the results that "dexmedetomidine was a better neuraxial adjuvant compared with clonidine as it leads to an earlier onset of sensory analgesia and prolongation of the post-operative analgesia".

In the present study, the mean onset time for motor block was found to be 239.05±62.21 seconds. This was in accordance with the study by Munshi et al.[19] in which, the mean motor block onset

time was 4.82±1.43 minutes, Swami et al.[18] in which, the mean motor block onset time was 4.65±2.46 minutes for supraclavicular brachial plexus block. While the mean onset time for motor block in the study by Agarwal et al.[20] was 16.2±1.8 minutes and Hosalli et al.[17] (the mean motor onset time was 14.93±1.84 minutes).

The mean duration of motor block was 1059.35±252.35 seconds. This was similar to the study by Singh et al (the mean duration of motor block was 17.52±2.098 minutes).[16] In the study by Zhang et al., the duration of sensory and motor blockade was prolonged among patients who received dexmedetomidine (50 µg) in comparison to control group for axillary brachial plexus blockade.[25]

The mean duration of analgesia was 1254.60±243.62 minutes which was much less than the study by Munshi et al.[18] in which, the mean duration of analgesia was 499±59.50 minutes, Swami et al.[19] in which, the mean duration of analgesia was 456.21±97.99 minutes. The mean SBP and DBP decreased from 0 minutes to 120 minutes in the present study but there was no sudden drop. This was similar to the study by Agarwal et al.[20] and Hosalli et al.[17] in which, the SBP and DBP showed similar changes from 0 minute to 120 minutes.

The mean HR decreased from 0 minutes to 120 minutes in the present study. This was similar to the study by Agarwal et al.[20] Masuki et al evaluated the effect of dexmedetomidine with levobupivacaine in the human forearm, in which, the PR showed similar changes from 0 minute to 120 minutes.

The mean MAP decreased steadily in the present study from 0 minute to 120 minutes which was similar to the study by Singh et al.[16] and Hosalli et al.[17] No side effects were observed during the course of our study.

CONCLUSION

To conclude, in our study we observed that "dexmedetomidine together with levobupivacaine for brachial plexus block (supraclavicular technique)" decreases the onset time for sensory/motor blocks and increase their duration. The significantly prolonged duration of analgesia obviates the need for any additional analgesics. The added advantage of conscious sedation, hemodynamic stability, and minimal side effects makes it a potential adjuvant for nerve blocks.

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